## CLAIMS

What is claimed is:

1. A method for producing a composite ceramic article having a nano-scaled grain structure, the method comprising the steps of:

forming a metastable ceramic material;

pressure sintering the material at a temperature ranging between 25% and 60% of the melting point of the material and at a pressure ranging between 1.5 GPa and 8.0 GPa thereby forming the composite ceramic article.

2. The method according to claim 1, wherein the metastable ceramic material forming step includes solidifying molten particles of a ceramic powder mixture.

3. The method according to claim 2, wherein the solidifying step includes quenching the molten particles of the ceramic powder mixture at a cooling rate of at least $10^4$ °K/sec.

4. The method according to claim 2, wherein the molten particles of the ceramic powder mixture are generated by plasma spraying the ceramic powder mixture.

5. The method according to claim 4, wherein the ceramic powder mixture includes $Al_2O_3$ and $TiO_2$.

6. The method according to claim 2, wherein the ceramic powder mixture includes $Al_2O_3$ and $TiO_2$.

7. The method according to claim 1, wherein the metastable ceramic material forming step includes spraying molten particles of a ceramic powder mixture against water.

8. The method according to claim 1, wherein the substrate comprises a cooled metallic chill plate.

9. The method according to claim 1, wherein the metastable ceramic material forming step includes mixing a first phase of ceramic material with a second phase of ceramic material, the second phase being at least 5 volume percent of the first phase.

10. The method according to claim 1, wherein the metastable ceramic material forming step includes mixing a first phase of ceramic material with a second phase of ceramic material to form a near eutectic composition.

11. The method according to claim 1, wherein the metastable ceramic material forming step includes mixing a first phase of ceramic material having micron-scale particles with a second phase of ceramic material having nano-scale particles.

12. The method according to claim 1, wherein the metastable ceramic material forming step includes mixing a first phase of ceramic material with a second phase of ceramic material in a ratio ranging between 60:40 and 40:60.

13. The method according to claim 12, wherein the first and second phases of the composite ceramic article form three dimensional interconnected networks of each phase.

14. A composite ceramic article comprising;

a first phase of ceramic material; and

a second phase of ceramic material;

wherein the first and second phases form three dimensional interconnected networks of each phase.

15. The composite ceramic product according to claim 14, wherein the first and second phases of ceramic material have a nano-scaled grain size.

16. The composite ceramic product according to claim 14, wherein the second phase has a volume fraction that exceeds 5 volume percent.

17. The composite ceramic product according to claim 14, wherein the second phase includes particles which are distributed along grain boundaries of the first phase.

18. The composite ceramic product according to claim 14, wherein the second phase includes particles which are homogeneously distributed so that each grain boundary of the first phase is surrounded by up to 10 particles of the second phase.

19. The composite ceramic product according to claim 14, wherein the average spacing between particles of the second phase is no greater than twice the average grain size of the first phase.

20. A metastable product comprising:

a first immiscible phase of ceramic material; and

a second immiscible phase of ceramic material;

wherein the first and second immiscible phases of ceramic material form a solid solution.

21. The metastable product according to claim 20, wherein the product is in the form of one of a powder, coating, and preform.